

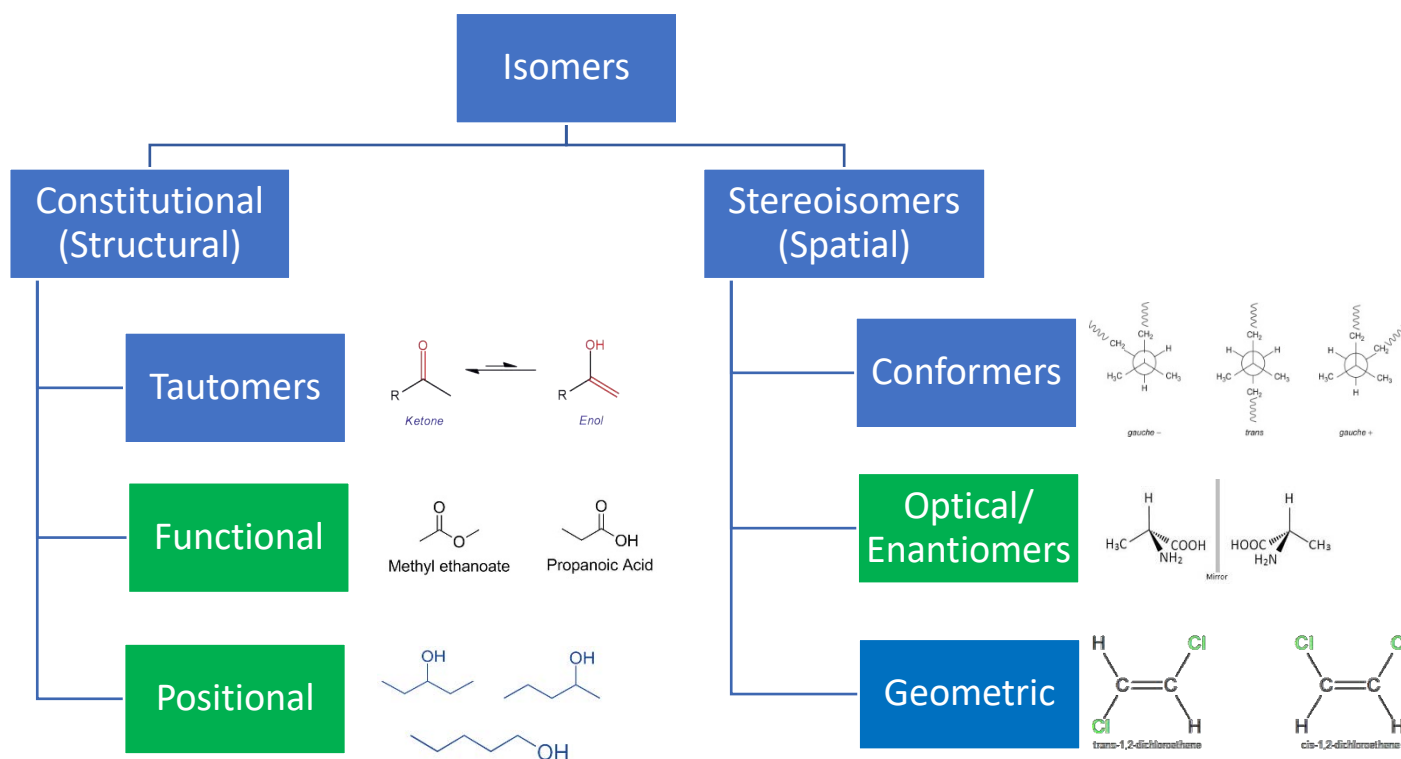
## DECLARATION

I, Heather L. Harris, state the following based on knowledge, information and belief:

1. I am a forensic chemistry consultant and assistant professor of forensic science employed by Arcadia University in Glenside PA. Prior to consulting and teaching, I was a forensic chemist at NMS Labs in Willow Grove PA and a forensic scientist in the chemistry section of the Bexar County Criminal Investigation Laboratory in San Antonio TX.
2. I have been involved in the field of chemistry, and specifically forensic chemistry, for over twenty years. In addition to studying chemistry and forensic science at the University of North Texas and The George Washington University, I have been an instructor in chemistry and forensic science at The George Washington University, Villanova University, and presently Arcadia University.
3. In addition to my education, training and professional experience as a forensic chemist, I am certified by the American Board of Criminalistics in two areas: Comprehensive Criminalistics and Drug Analysis. I participate in professional organizations, such as the American Academy of Forensic Sciences, the American Chemical Society, and AOAC International. The full details of my background are included in my attached CV.
4. Through his attorney, Mr. Henry has asked me to review the legal definitions of “methamphetamine” and its isomers under Minnesota and federal law to determine whether any substances criminalized under Minnesota law would be legal under federal law. As explained in this affidavit, it is my conclusion that the Minnesota definition of “methamphetamine” and its isomers is broader than the federal definition. As a result, certain substances would be controlled in Minnesota that would not be controlled under federal law.
5. To begin, an isomer is one of several molecular entities that have the same atomic composition but a different physical or spatial arrangement of the atoms in the molecule. As a result, isomers are different molecules and can have different physical and chemical properties.
6. Two main categories of isomers are constitutional isomers and stereoisomers. Constitutional, or structural, isomers have the same number of atoms of each element, but the atoms are connected in different ways. Stereoisomers, also known as spatial isomers, have the same number of atoms bonded together in the same way, but they differ only in their spatial arrangements in the molecules.
7. These two main categories of isomers each further contain a variety of more specific types of isomers. For example, constitutional isomers include tautomers, functional isomers, and positional isomers. Stereoisomers include conformers, optical isomers (enantiomers), and geometric isomers. The following figure illustrates these relationships.

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8. The analysis in this affidavit focuses primarily on three isomer types: optical, positional, and functional. Optical isomers are types of stereoisomers. Positional and functional isomers are types of constitutional, or structural, isomers. These are highlighted in green in the figure above.
9. Under Minnesota law, methamphetamine is controlled by the following listing in Schedule II:
- Unless specifically excepted or unless listed in another schedule, any material, compound, mixture, or preparation which contains any quantity of the following substances having a stimulant effect on the central nervous system:
- (2) methamphetamine, its salts, *isomers*, and salts of *its isomers*.<sup>1</sup>
10. Due to the italicized language above, all isomers of methamphetamine are included in the scheduling of methamphetamine under Minnesota law. It does not appear that the term “isomer” is further defined or delimited under Minnesota law with respect to methamphetamine.
11. Notably, Minnesota law does limit the isomers that are controlled with respect to other substances. For example, this same Schedule II listing includes “amphetamine, its salts, *optical isomers*, and salts of *optical isomers*.”<sup>2</sup> Thus, with respect to methamphetamine,

<sup>1</sup> Minn. Stat. §152.02 (3)(d)(2).

<sup>2</sup> Minn. Stat. §152.02 (3)(d)(1).

the basic meaning of the term “isomer” applies, which means that all constitutional isomers and stereoisomers of methamphetamine, except where listed in another schedule, would be included as methamphetamine under Minnesota law

12. Federal controlled substance law is ultimately more specific. Federal law actually schedules methamphetamine using the same language as Minnesota:

Unless specifically excepted or unless listed in another schedule, any material, compound, mixture, or preparation which contains any quantity of the following substances having a stimulant effect on the central nervous system:

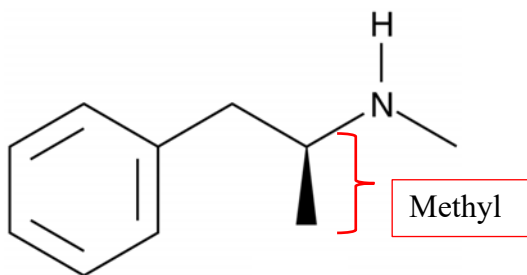
(2) methamphetamine, its salts, *isomers*, and salts of *its isomers*.<sup>3</sup>

13. However, under federal law “isomer” is defined to include only the optical isomer.<sup>4</sup>

When this definition of isomer is applied to the Schedule II listing of methamphetamine, it results that only the optical isomers of methamphetamine are controlled under federal law.

14. Therefore, federal controlled substance law criminalizes methamphetamine and its optical isomers only. It does not criminalize any geometric or structural isomers of methamphetamine. In contrast, Minnesota law controls all isomers of methamphetamine, both structural isomers and stereoisomers, which includes optical isomers. As a result, Minnesota law criminalizes substances that would not be controlled under federal law.

15. In the context of criminal prosecutions, the term “methamphetamine” generally means the psychoactive street form of the substance, which is *d*-methamphetamine.



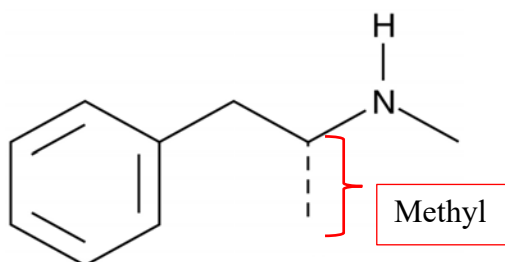
*d*-methamphetamine<sup>5</sup>

16. *d*-methamphetamine possesses one optical isomer, *l*-methamphetamine, which is a non-psychoactive decongestant found in over-the-counter products. These two forms are identical in their construction but are non-superimposable mirror images, just like a pair of human hands.

<sup>3</sup> 21 CFR §1308.12 (d)(2).

<sup>4</sup> 21 U.S.C. § 802(14).

<sup>5</sup> [https://www.caymanchem.com/product/13997/\(%2B\)-methamphetamine-\(hydrochloride\)](https://www.caymanchem.com/product/13997/(%2B)-methamphetamine-(hydrochloride))



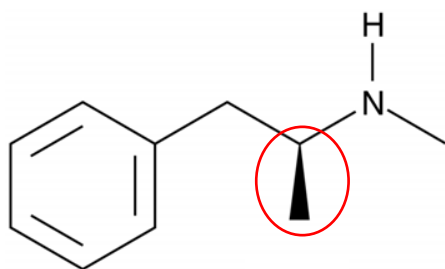
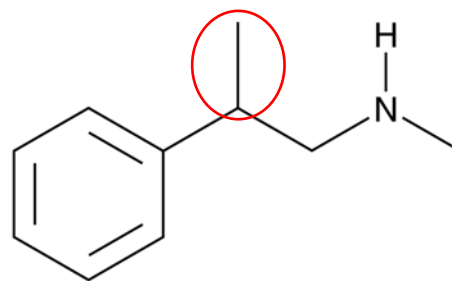
*l*-methamphetamine<sup>6</sup>

17. In these diagrams, the difference between the *d* and *l* forms is visible in the direction of the methyl group extending down from the horizontal carbon chain. In *d*-methamphetamine, the methyl group is projecting toward the viewer. It is projecting away from the viewer in the *l* form. These two forms are optical isomers.
18. Methamphetamine, in both forms, has a molecular weight of 149.23 g/mol and a molecular formula of C<sub>10</sub>H<sub>15</sub>N.<sup>7</sup> It contains a single chiral carbon atom, which allows for the different spatial arrangements of the *d*- and *l*- forms. Both of these isomers would be controlled under both federal and Minnesota law.
19. However, methamphetamine also possesses a number of structural isomers. These compounds would be controlled in Minnesota but would not be controlled federally.
20. Methamphetamine belongs to a group of compounds known as phenethylamines. This group contains at least five compounds that are positional isomers of methamphetamine, one of which is phentermine, a Schedule IV controlled substance both federally and in Minnesota.
21. An unscheduled positional isomer in this group is the compound phenpromethamine, a nasal decongestant once marketed under the brand name, Vonedrine.<sup>8</sup> Phenpromethamine possesses the same atomic composition as methamphetamine, but the two compounds differ in the position of a single methyl (CH<sub>3</sub>) group on the molecule.
22. Like the methamphetamine optical isomers, phenpromethamine has a molecular weight of 149.23 g/mol and a molecular formula of C<sub>10</sub>H<sub>15</sub>N. Unlike methamphetamine and its optical isomer, which is simply a different orientation of the same molecule in three-dimensional space, phenpromethamine possesses a single methyl group at a different location on the molecule.

<sup>6</sup> [https://www.caymanchem.com/product/13998/\(%E2%88%92\)-methamphetamine-\(hydrochloride\)](https://www.caymanchem.com/product/13998/(%E2%88%92)-methamphetamine-(hydrochloride))

<sup>7</sup> <https://pubchem.ncbi.nlm.nih.gov/compound/Methamphetamine>

<sup>8</sup> <https://pubchem.ncbi.nlm.nih.gov/compound/22276>

*d*-methamphetamine<sup>9</sup>phenpromethamine<sup>10</sup>

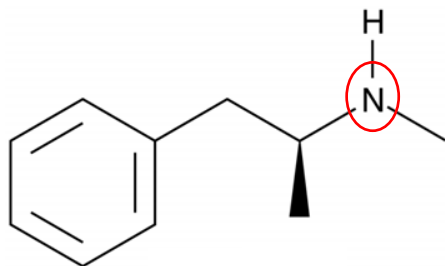
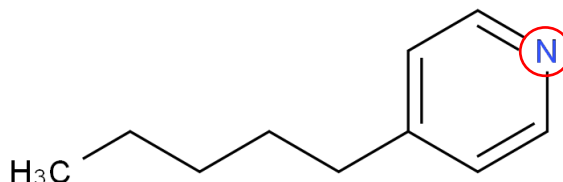
23. The diagrams above show *d*-methamphetamine on the left and phenpromethamine on the right. The position of the relevant methyl group is extending down from the horizontal carbon chain in this methamphetamine diagram.
24. Phenpromethamine is a positional isomer of methamphetamine because that relevant methyl group has moved one carbon to the left and is now extended upward from the carbon chain. This change in position creates a new compound with the same molecular weight and the same molecular formula but with a different chemical structure.
25. The change in position of this methyl group does not create any new chemical functionality and it does not destroy any existing chemical functionality. As a result, methamphetamine and phenpromethamine are positional isomers.<sup>11</sup>
26. Under the Minnesota statute, phenpromethamine would be included as a controlled substance because it is an isomer of methamphetamine. It would not be a controlled substance under the federal statute because it is not an optical isomer. The federal definition of methamphetamine does not include positional isomers, such as phenpromethamine.
27. Another compound that would be controlled in Minnesota but would not be controlled federally is 4-pentylpyridine, a functional isomer of methamphetamine.<sup>12</sup> A functional isomer is a structural isomer bearing a different functional group, which is a group of atoms in a molecule with distinctive chemical properties. As with phenpromethamine, 4-pentylpyridine possesses the same molecular weight and formula as methamphetamine, but the two compounds differ in the position of the nitrogen atom in the molecule. This results in different functional groups in the two molecules.

<sup>9</sup> [https://www.caymanchem.com/product/13997/\(%2B\)-methamphetamine-\(hydrochloride\)](https://www.caymanchem.com/product/13997/(%2B)-methamphetamine-(hydrochloride))

<sup>10</sup> <https://www.caymanchem.com/product/18563>

<sup>11</sup> Definition of “Positional Isomer” as It Pertains to the Control of Schedule I Controlled Substances, 72 Fed Reg, 67850 (Dec 3, 2007). It is noted that methamphetamine is not a Schedule I substance, but no federal definition of positional isomers for Schedule II substances exists as they are not included in the definition of methamphetamine.

<sup>12</sup> <https://pubchem.ncbi.nlm.nih.gov/compound/72918>

*d*-methamphetamine<sup>13</sup>4-pentylpyridine<sup>14</sup>

28. The diagrams above show *d*-methamphetamine on the left and 4-pentylpyridine on the right. The position of the relevant nitrogen atom is included in the carbon chain in this methamphetamine diagram.
29. 4-pentylpyridine is a functional isomer of methamphetamine because that relevant nitrogen atom is bonded in the molecule differently. In 4-pentylpyridine, the nitrogen atom is included in the ring portion of the molecule. This results in a different functional group.
30. Methamphetamine contains the nitrogen atom within a secondary amine functional group included in the carbon chain. 4-pentylpyridine contains the nitrogen atom within the ring structure, which is the functional group pyridine.
31. This difference in bonding creates a new compound with the same molecular weight and the same molecular formula but with a different chemical structure. It also results in a change in chemical functionality. As a result, methamphetamine and 4-pentylpyridine are functional isomers.
32. Under the Minnesota statute, 4-pentylpyridine would be included as a controlled substance because it is an isomer of methamphetamine. It would not be a controlled substance under the federal statute because it is not an optical isomer. The federal definition of methamphetamine does not include functional isomers.
33. In conclusion, based on my education, training and experience in the field of forensic chemistry and on my evaluation described above, structural isomers of methamphetamine exist that would be controlled in Minnesota that would not be controlled federally. The federal definition restricts isomers of methamphetamine to optical isomers only. The Minnesota definition controls all isomers generally with respect to methamphetamine. Using the plain meaning of this term, the Minnesota definition of isomer, as it applies to methamphetamine, is much broader than the federal definition. As a result, these structural isomers would be criminalized in Minnesota while being legal federally.

<sup>13</sup> [https://www.caymanchem.com/product/13997/\(\(%2B\)-methamphetamine-\(hydrochloride\)\)](https://www.caymanchem.com/product/13997/((%2B)-methamphetamine-(hydrochloride)))

<sup>14</sup> <https://webbook.nist.gov/cgi/cbook.cgi?ID=C2961504&Units=SI&Mask=200>

I declare under penalty of perjury that the foregoing is true and correct. Executed on this 12<sup>th</sup> day of October, 2021.

*Heather L. Harris*

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Heather L. Harris, MFS, JD, ABC-CC, ABC-DA